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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/762,764
Filing Date: January 22, 2004
Appellant(s): XI ET AL.

David A. Zarneke
For Appellant

EXAMINER'S ANSWER

MAILED

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This is in response to the appeal brief filed 3/9/06 appealing from the Office action mailed 10/17/05.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

No evidence is relied upon by the examiner in the rejection of the claims under appeal.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claim 16-18, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700.

Kang teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate having a via, said method comprising:

a) forming a refractory metal nucleation layer, WN, by serially exposing said substrate to first and second reactive gases (claim 16), wherein the refractory metal nucleation layer covers the via; and

b) forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases, wherein the bulk deposition layer fills the via (6, 13+), wherein the refractory metal is tungsten (2, 65+).

While Kang fails to explicitly teach the tungsten is the bulk deposition layer filling the via, the examiner takes "official notice" since the claimed subject matter is notoriously well-known in the art (MPEP 2144.03), as evinced by applicant's own admitted prior art (APA) ([0005]-[0006]) and Chang et al., US Patent 5,028,565. The bulk deposition of tungsten into the via of Kang is notoriously well known in the art. Tungsten is very commonly used to fill vias, as taught by the APA and Chang references. Therefore, Kang's teaching (6, 13+) that a tungsten CVD chamber can be added to the cluster tool can be used for the bulk deposition of tungsten in to the via.

Further, Kang fails to teach the use of a plurality of vias.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a plurality of vias in the invention of Kang because the mere duplication of parts has no patentable significance unless a new and unexpected result is produced (In re Harza, 124 USPQ 378 (CCPA 1960)).

With respect to claim 17, Kang teaches the bulk deposition layer is deposited using chemical vapor deposition ((6, 13+).

As to claim 18, while Kang teaches the use of a separate chambers within a transfer chamber, It would have been obvious to one of ordinary skill in the art at the time of the invention to use a single chamber because the performance of two steps simultaneously, which have previously been performed in sequence was held to have been obvious [In re Tatincloux 108 USPQ 125 (CCPA 1955)].

In re claim 20, Kang teaches the use of WF_6 (2, 65+).

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700 (Kang 700), as applied to claim 19 above, and further in view of Kang et al., U.S. Patent 6,287,965 (Kang 965).

Kang 700 fails to teach the first reactive gas is diborane.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by diborane or any other B compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer, especially in view of Takagi et al., US Patent 6,107,200 (abstract), and Authier et al. US Patent 4,113,532 (2, 29-39).

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700 (Kang 700), in view of Kang et al., U.S. Patent 6,287,965 (Kang 965).

Kang 700 teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising:

forming a refractory metal nucleation layer by serially exposing said substrate to a first gaseous compound and a tungsten-containing compound (claim 8), wherein the serially exposing said substrate to a first gaseous compound and a tungsten-containing compound comprises:

exposing said substrate to the first gaseous compound for a period of time;

exposing said substrate to a pulse of the tungsten-containing compound; and

exposing said substrate to the first gaseous compound; and
forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first gaseous compound and tungsten-containing compound.

Regarding the use a boron-containing compound as the first gaseous compound, Kang 700 fails to teach the first reactive gas is a boron-containing compound.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by a B compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily

surmise that a B-compound would be used to supply the boron to the layer, especially in view of Takagi et al., US Patent 6,107,200 (abstract), and Authier et al. US Patent 4,113,532 (2, 29-39).

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

While Kang fails to explicitly teach the tungsten is the bulk deposition layer filling the via, the examiner takes "official notice" since the claimed subject matter is notoriously well-known in the art (MPEP 2144.03), as evinced by applicant's own admitted prior art (APA) ([0005]-[0006]) and Chang et al., US Patent 5,028,565. The bulk deposition of tungsten of Kang is notoriously well known in the art. Tungsten is very commonly used to fill vias, as taught by the APA and Chang. Therefore, Kang's teaching (6, 13+) that a tungsten CVD chamber can be added to the cluster tool can be used for the bulk deposition of tungsten in to the via.

As to the period of time and the "pulse", which the examiner is assuming means the same as "a period of time" because there is nothing in the specification providing a definition or time limit for "pulse", Kang teaches exposing the substrate to the gases, and therefore it inherently is exposed for both a period of time and a pulse.

In re the second exposing the substrate to the first reactive gas step, Kang teaches repeating the steps of exposing the substrate to both the first and second

reactive gas (2, 55+, step (g)). Since the present claims use comprising language the addition of a further step of exposing the substrate to the second reactive gas after the pulse of the first reactive gas is permissible (MPEP 2111.03).

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kang et al., U.S. Patent 6,139,700 (Kang 700), in view of Kang et al., U.S. Patent 6,287,965 (Kang 965).

Kang 700 teaches a method of forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising:

forming a refractory metal nucleation layer by serially exposing said substrate to a first gaseous compound and a tungsten-containing compound (claim 8), wherein the serially exposing said substrate to a first gaseous compound and a tungsten-containing compound comprises:

exposing said substrate to a pulse of the first gaseous compound;

exposing said substrate to a pulse of the tungsten-containing compound;

and

exposing said substrate to the first gaseous compound for a period of time; and

forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first gaseous compound and tungsten-containing compound.

Regarding the use a boron-containing compound as the first gaseous compound, Kang 700 fails to teach the first reactive gas is a boron-containing compound.

The Examiner points out that the comprising language of the present claims do not rule out the inclusion of a 3rd reactive gas to form a WBN layer.

Kang '965 teaches forming an ALD WBN layer followed by a W lower electrode layer (8, 1+). While not specifically stating that the B is supplied by a B compound, the examples given relate to the formation of a TiAlN layer wherein all the components are supplied as compounds (8, 27+). One of ordinary skill in the art could then easily surmise that a B-compound would be used to supply the boron to the layer, especially in view of Takagi et al., US Patent 6,107,200 (abstract), and Authier et al. US Patent 4,113,532 (2, 29-39).

The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

While Kang fails to explicitly teach the tungsten is the bulk deposition layer filling the via, the examiner takes "official notice" since the claimed subject matter is notoriously well-known in the art (MPEP 2144.03), as evinced by applicant's own admitted prior art (APA) ([0005]-[0006]) and Chang et al., US Patent 5,028,565. The bulk deposition of tungsten of Kang is notoriously well known in the art. Tungsten is very commonly used to fill vias, as taught by the APA and Chang. Therefore, Kang's teaching (6, 13+) that a tungsten CVD chamber can be added to the cluster tool can be used for the bulk deposition of tungsten in to the via.

As to the period of time and the "pulse", which the examiner is assuming means the same as "a period of time" because there is nothing in the specification providing a definition or time limit for "pulse", Kang teaches exposing the substrate to the gases, and therefore it inherently is exposed for both a period of time and a pulse.

In re the second exposing the substrate to the first reactive gas step, Kang teaches repeating the steps of exposing the substrate to both the first and second reactive gas (2, 55+, step (g)). Since the present claims use comprising language the addition of a further step of exposing the substrate to the second reactive gas after the pulse of the first reactive gas is permissible (MPEP 2111.03).

Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 16-20, 23 and 26 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4 of U.S.

Patent No. 6,620,723 in view of Wolf, Silicon Processing for the VLSI Era: Volume 2 – Process Integration, 1990, pp 192-194.

Although the conflicting claims are not identical, they are not patentably distinct from each other because the present claim are broader, in terms of the nucleation layer not being a boride layer specifically, and further add the bulk deposition layer. The forming of a bulk deposition layer is an obvious next step after forming a nucleation layer that would have been obvious to one of ordinary skill in the art.

Claims 16-20, 23 and 26 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-34 of U.S. Patent No. 6,831,004.

Although the conflicting claims are not identical, they are not patentably distinct from each other because the present claim are broader, in terms of the nucleation layer not being a boride layer specifically, and further add the bulk deposition layer. The forming of a bulk deposition layer is an obvious next step after forming a nucleation layer that would have been obvious to one of ordinary skill in the art.

Claims 16-20, 23 and 26 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-28 of copending Application No. 10/993925. Although the conflicting claims are not identical, they are not patentably distinct from each other because the present claim are broader, in terms of the nucleation layer not being a boride layer specifically, and further add the bulk deposition layer. The forming of a bulk deposition layer is an obvious next

step after forming a nucleation layer that would have been obvious to one of ordinary skill in the art.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

(10) Response to Argument

Essentially, there are four (4) arguments presented. They are:

A) It is argued that Kang doesn't teach the bulk deposition of tungsten (W) on the claimed nucleation layer to fill the via. Kang's teaching of a W-CVD chamber (6, 13+) does not necessarily mean it is meant that the W would fill the via. Further, the cited reference to Chang doesn't teach depositing W to fill the via wherein the nucleation layer is formed as claimed. Notice that this same argument is made with respect to each independent claim 16, 23 and 26.

Please note that the rejection is a combination of the references to Kang, Chang and Applicant's admitted prior art (APA). Kang is relied upon to teach the deposition of a nucleation layer into vias formed as claimed in the present application and the reference to a metal line and a W-CVD chamber. Chang and APA teach a nucleation layer formed in vias and filling the remaining portion of the via with W using CVD. The combination of references result in a via with a nucleation layer formed as claimed and a bulk deposited W layer, as claimed. Chang and APA don't have to teach the claimed method of forming the nucleation layer to render obvious the filling of a via with a nucleation layer therein with a W bulk deposition layer. As stated in the rejection and

agreed to by applicant (Appeal Brief, page 11, lines 7-11), "As any and every skilled artisan would attest, the next logical step after formation of the nucleation layer would be to fill it with a bulk deposition layer, including a W layer."

B) Second, with respect to claim 23, it is argued that the Takagi and Authier references fail to teach depositing a nucleation layer formed by serially exposing a reactive gas of a boron-containing compound and a tungsten-containing compound. As noted above, the rejection is a combination of the references. Takagi and Authier are relied upon to teach the use of diborane as a boron-containing compound used to react with a tungsten-containing compound. The fact that Takagi and Authier don't teach the method as claimed is irrelevant because they are not relied upon to teach this method. Kang and Kang teach this method and Takagi and Authier simply teach that the boron-containing compound can be a diborane.

C) Next, as to the double patenting rejections, it is argued that while Wolf teaches the CVD of tungsten in interconnects, it doesn't teach the nucleation layer is formed using the claimed method. As discussed above, this argument attacks the references individually and fails to consider the rejection as a combination of references. Wolf doesn't have to teach the claimed method of forming the nucleation layer to be a combinable reference.

D) Lastly, also with regard to the double patenting rejections, it is argued that the rejections statement that the bulk deposition layer is a next obvious step after forming the nucleation layer is not a sufficient finding or support for an obvious statement.

The patents only teach the formation of the nucleation layer, the present claims add the step of filling the remainder of the via with a W bulk deposition layer. Applicant (Appeal Brief, page 11, lines 7-11) has previously agreed with the rejection's statement "As any and every skilled artisan would attest, the next logical step after formation of the nucleation layer would be to fill it with a bulk deposition layer, including a W layer." Therefore, the rejection's inclusion of Wolf's teaching of the use of a W bulk deposition layer in a via and Applicant's previous agreement with the rejection's statement that a skilled artisan would know that the next logical step would be to fill the vias with a metal and the metal is readily known to include W, is the support for this obviousness statement.

The only other issue is the patents state a boride layer while the present claims require a nucleation layer. The term "nucleation layer" is broader than the term "boride layer". This is obvious upon reading claims 23 and 26 of the present invention, which state that the nucleation layer comprises a boron-containing compound and a tungsten-containing compound which results essentially in a tungsten containing boride layer.


(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

David Zarneke


PRIMARY EXAM David Zarneke

Conferees:



Drew Dunn 

Sandra O'Shea

